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ABSTRACT

This paper describes how a water monitoring program uses a science research paper to help students apply knowledge learned from the field, the lab, and class discussion. The application consists of examining water quality data of a river and determining what factors had an impact on the river, either biotic or abiotic. Students are asked to analyze and draw conclusions from site data. The learning outcomes for the student include an awareness of the cause and effect relationship of biotic and abiotic factors as they relate to water quality. Steps students can use to conduct water monitoring in local waterways and how to present their results in a science research paper are outlined. (AIM)

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The Writing of the Scientific Paper to Help Students Process Water Quality Data.

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A water quality monitoring program that uses the science research paper to help student apply the knowledge that they learned in the field, the lab and through class discussion. This application consisted of examining the water quality data of the river examined and determine what factors, biotic and/or abiotic, had an impact on the river. The paper is designed to aid students in analyzing and drawing conclusions from their site data. This activity has resulted in the students being aware of cause and effect relationships as they relate to water quality, and have lead the students to demonstrate personal ownership and concern of our waterway.

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The Writing of the Scientific Paper

to Help Students Process Water Quality Data

by Gerald Friday

INTRODUCTION

Biology classes throughout the nation have taken on the task of determining the water quality of our streams and rivers. This activity may be nationally known as Testing The Waters, Save Our Streams or by a variety of other names. No matter what it's called, the activity is very rewarding. It not only provides an opportunity for the teaching of environmental awareness but it also promotes the postulates that science teachers look for; observing, analyzing and experimenting.

The inclusion of having the students write a scientific paper helps them not only to organize their water quality data but it also facilitates the student's in analyzing their data and promotes the concluding of the overall water quality of their waterway.

METHODS

My preference is to divide the class into small groups, each group then studies a section of our local river. Each group writes a scientific paper about their site and also shares the data and their conclusions about their site at a class forum. If it is not possible to examine several sites on your waterway, than one group would work out fine, each student then writing their scientific paper. The results of these papers can then be discussed.

The students are given instructions on how to safely collect water samples and how to analyze them. There are a variety of methods that can be used. For this, I prefer to follow the guidelines of the National Sanitation Foundation, which can be found in most

manuals on testing river water quality. The National Sanitation Foundation has selected nine tests to determine water quality. These tests are dissolved oxygen, fecal coliform bacteria, pH, B.O.D., temperature, total phosphates, nitrates, turbidity and total solids. Each test is weighed according to its value relative to the other tests and though a series of calculations the total water quality can be determined. Each group or class, collect three water samples. The first is analyzed on the site for dissolved oxygen, pH, temperature and turbidity. Back at school, one of the samples was covered with foil so that 5 days later it could be analyzed for biological oxygen demand. The remaining sample is used to examine for fecal coliform bacteria, phosphate levels, nitrate concentrations and total solids.

A significant amount of time and care is spent in the classroom lab testing the river water returned to school. Supplemental readings are assigned to help students understand how environmental conditions can have an effect on water quality. The results of those tests along with the test data from the field trip, assist the students in calculating the water quality of their site. The hands-on experience of going out into the environment to observe, combined with the classroom work of analyzing and interpreting data, provides the students with a practical yet exciting atmosphere in which they can learn and experience the scientific process.

Once the students have determined the water quality of their site, they are asked to write a scientific paper. The format of their paper is very similar to the organization of this paper. It is composed of a title, introduction, methods, results, discussion and summary.

1. The title focuses on the theme of the paper.
2. The introduction describes the river and the site from which the water was collected.
3. The methods are an overview of the various tests used in determining water water quality.

4. The results contain the collected data in the form of charts and tables.
5. The discussion provides the students an opportunity to analyze their data and determine the various factors that were influential in determining the water quality of the river.
6. The summary is very version of the discussion. The summary is limited to a statement of the overall water quality of the river and a statement as to the factors involved in this water quality rating.

The paper will be about two pages in length.

It is recommended that the class be divided into several groups and each group analyzes a specific river site. Each group is responsible for their scientific paper and an oral presentation about their site. A water forum is created with each group or team portraying their watershed, using maps and slides so we, the audience, have a good visual picture of what their watershed is like. The data is presented and its significance is explained. The students can hypothesize how the surroundings of their site, such as a forest, golf course or parking lot can effect the water quality of the river. By having the students share the results of the numerous sites along the river, students are able to learn about how the change in the environment effects the river as it flows from one environmental setting to another.

RESULTS

Listed below are two tables. The first table shows the water quality index ranges and their relative water quality while the second table is the data that the class collected at one of our sites along our local river, the Menomonee river. The second table also shows water quality of each factor (Q-value) and the weighting factors for each of the nine tests performed.

Water Quality Index Ranges

90-100	Excellent
70-90	Good
50-70	Medium
25-50	Bad
0-25	Very Bad

Menomonee River, Bluemound Bridge Site, 4/20/1996

Tests	Test Results	Q-Value	Weighting Factors	Total
Dissolved oxygen	130 ISat	85	0.17	14.45
Fecal coliform	220 c/100ml	37	0.14	5.92
pH	8 units	85	0.11	9.35
B.O.D.	1 mg/l	96	0.11	10.56
Temperature	2 degree change	87	0.10	8.70
Total Phosphates	0 mg/l	99	0.10	9.90
Nitrates	0.26 mg/l	98	0.10	9.80
Turbidity	2 1/2 ft.	28	0.08	2.24
Total Solids	820 mg/l	20	0.07	1.40

The overall water quality index of this site is 72.42.

DISCUSSION

The results of the river study have been very gratifying to me as a teacher. Students have exhibited a considerable amounts of interest, motivation and learning during this unit. The water quality monitor testing along with the class discussions has allowed for student understanding of the dynamics of river ecology, both from an abiotic and biotic

prospective.

The writing of a science research paper provides the students with a vehicle to synthesize their learning from the class discussions and the data gathers from the water quality monitoring. The paper framework of title, introduction, methods, results, discussion and summary provide the students with a framework to facilitate an organized method to review and analyze their data and knowledge. The writing of the paper gives the students a chance to apply the concepts and information discussed in class.

For example, students are likely to write, based upon the data in the results that the water quality of the Menomonee River was calculated to be in the good range. The good water quality was helped in part by the outstanding results from the low levels of phosphates, nitrates and organic matter that are found in the river. This may be due to the condition that the industries along the river are regulated and that the river's length is mostly in the city and not in the country where farms may pollute the river with these materials. The golf course that is up river uses fertilizers that are natural rather than synthetic, thus low in these materials. The bridges and lack of a good buffer zone allow for considerable run off into the river as noted by the poor rating of turbidity and total solids. There are numerous construction companies that are at the river's edge which also account for gravel and sand getting into the river. Large populations of ducks and geese live along the river and people walk their dogs along walkways that are close to the river. This would account for the poor rating of water quality due to the high levels of fecal coliform found in the water. The river water does increase in temperature as it flows along its journey because the river is open near this site.

The oral presentation furnishes the student with the opportunity of presenting their paper and sharing information with their classmates. These presentations provide the students with an understanding of the dynamics of river ecology changes as the river travels its course. Students learn, first hand, how the various environmental factors can

have an impact upon the water quality of the river. An important aspect of the presentations is for the students to include cause and effect relationship and explain ways that some of the negative relationships can be improved.

This unit has lead to the students displaying responsibility for their river. Students have become more involved in community river clean up projects and have shown a genuine concern about the quality of our waterways.

SUMMARY

The science research paper has provided an opportunity for students to apply the knowledge that they learned in the field, the lab and through class discussion. This application consisted of examining the water quality data of the river examined and determine what factors, biotic and/or abiotic, had an impact on the river.

This type of an activity has fostered student interest in local watersheds and has provided a stimulus for them to become involved in improving local water quality. Many of the students have gone beyond the scope of this project by writing letters to companies along the river, encouraging them to take better care it. Some students have volunteered for river cleanup groups while others have communicated about water shed issues with students from other schools. These students use their acquired knowledge and skills in taking thoughtful, positive action toward the resolution of environmental issues, thus making a contribution to their community.

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